Citation:

Newby PK, Peterson KE, Berkey CS, Leppert J, Willett WC, Colditz GA. Beverage consumption is not associated with changes in weight and body mass index among low-income preschool children in North Dakota. *J Am Diet Assoc*. 2004; 104: 1,086-1,094.

PubMed ID: 15215766

Study Design:

Cohort study (longitudinal, retrospective)

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine prospectively the association between beverage consumption (fruit juice, fruit drinks, milk, soda and diet soda) and changes in weight and body mass index among preschool children.

Inclusion Criteria:

See exclusion criteria.

Exclusion Criteria:

1. Only one clinic visit (N=7,834)
2. Underwent (BMI<5th) (N=686)
3. Implausible energy intake (<800kcal per day or >3,500kcal per day; N=447)
4. Unreasonable weight-for-age, weight-for-height, height-for-age (N=532)
5. *Time between visits:* Less than six months or more than 12 months (N=2,842)
6. Suspicious change in BMI (<-4 or >4kg/m^2) (N=71)
7. Breastfeeding at baseline (N=34).

Description of Study Protocol:

Recruitment

- North Dakota WIC participants (January 1995 to June 1998).

Statistical Analysis

- Beverages modeled individually and then together
- Three models for analysis as continuous as well as dichotomous beverages:

1. Adjust for gender, height change, baseline age and baseline energy intake
2. Further adjusted for birth weight, maternal education, race or ethnicity, residence and poverty level
3. Gender, height change and the above sociodemographic variables, but total energy intake was removed from analysis (because it may be in pathway to obesity).

- 'Indicator' sociodemographic data used if missing; also analysis done only on those with complete data (N=609)
- Multiple linear regression.

Data Collection Summary:

Timing of Measurements

- Two visits six to 12 months apart (if more than two visits, used the first two)
- *Mean duration between measures:* 8.4 months.

Dependent Variables

- BMI (measured height and weight)
  1. Annualized change in BMI and weight
  2. Overweight (BMI≥95th percentile).

Independent Variables

- Diet at baseline (semi-quantitative 84-item FFQ over the past month; previously validated with age group) as continuous (ounces per day) and dichotomized (≥12 ounces per day for fruit juice or drinks and ≥24 ounces per day for milk) intakes
  1. 100% fruit juice
  2. Fruit drinks
  3. Milk
  4. Soda (non-diet)
  5. Diet soda (no- or low-kcal).

Control Variables

- Gender
- Baseline weight
- Total energy intake
- Height change
- Sociodemographic variables.

Description of Actual Data Sample:

Initial N

- 17,232.

Attrition (final N)

- 1,345 children (670 females, 675 males).

Age

- Two to five years.

Ethnicity

- 83% white
- 12% Native American
- 5% other.

SES

- Low (all on WIC)
  - 54% to 57% <100% poverty level
  - 19% to 24% 100-133% poverty level
  - 24% to 23% >133-185% poverty level.

Location

- North Dakota.

Summary of Results:

Mechanism-Related

- All beverages correlated to total energy intake: strongest correlations for fruit drinks and soda ($R=0.23$, $P<0.001$)
- Weak inverse relationship between soda and milk ($R=-0.06$, $P<0.001$) and between milk and fruit drinks ($R=-0.09$, $P<0.001$)
- Soda increased and milk decreased with age (other beverages remained similar).

Relationship With Adiposity

- No significant relationship between beverage intake and weight or BMI change in any models
- Results did not change when change in beverage intake was used.

Author Conclusion:

- Our study does not show an association between beverage consumption and changes in weight or BMI in this population of low-income preschool children in North Dakota.
- Our results are consistent with other prospective studies that have found that fruit juice is not related to obesity, but they are inconsistent with some reports that have found that sweetened beverages, such as soda and fruit drinks, are related to obesity among older children.
- High intakes of fruit juice and milk and low intakes of soda, fruit drinks and diet soda were seen in this study, possibly related to the fact that WIC does not provide vouchers for sweetened beverages.
- Low intakes and limited variation of soda and fruit drinks in our sample likely limited our ability to see an association with these beverages and weight or BMI.
- Current scientific evidence does not support a positive association between fruit juice and milk consumption and obesity, hence they may still be recommended to children in reasonable amounts because they are an important source of nutrients and energy.

Reviewer Comments:

Strengths

- *Longitudinal analysis*
- *Included all beverages so minimal confounding of other beverages*
- *Control for numerous other variables (e.g., birthwt)*
- *Lots different ways explored to analyze data*

Limitations

- *Height and weight was measured in WIC setting, which probably did not involve the standardized procedures necessary for research studies, as evidenced by high numbers of unrealistic weight, height measures or change in BMI*
- *FFQ is semi-quantitative*
- *Low sweetened beverage intake may explain lack of findings (lesser intake in CSFII for same age group), maybe because they did not give vouchers for these or because of response bias (e.g., mother's reluctance to report "unhealthy" behaviors). Also note the relatively high fruit juice and milk intakes (mean fruit juice, 10.7oz per day, which is over twice the CSFII average for two- to 18-year-olds)*
- *Limited variation in intake of some beverages (e.g., fruit drinks, soda, diet soda)*
- *Beverage intake may be changing over the period of study (modest correlation between first and second measures)*
- *Six to 12 months may not be long enough to detect differences in this age group*
- *Unable to control for all possible confounders (e.g., parental OB, PA, TV)*
- *Preschool children may compensate better for caloric fluids (e.g., "breastfeeding" relative age, though none in the study were breastfeeding)*
- *Over half of subjects had some missing socio-demographic data and it is not clear how missing data was extrapolated.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	N/A
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes

4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	???
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes

7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	N/A
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes